AN

INTRODUCTORY LECTURE,

DELIVERED AT THE

National Eye Infirmary,

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BY

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ADVERTISEMENT.

THE following Lecture was not originally intended for publication, but, as the Governors of the National Eye Infirmary were pleased to think, that its circulation might promote the interests of the Institution, it has been printed at their desire.

Introductory Lecture,

&c. &c.

GENTLEMEN,

IT is almost superfluous for me to advert to the great importance of the subject to which I am about to direct your attention. It is scarcely necessary to observe that of all the senses, that of vision is, perhaps, the one most essential to our comfort and security. When we contrast the helpless condition of those who have been deprived of the blessing of sight, with the self confidence, and superior personal energy which they possess whose vision is unimpaired, we cannot sufficiently feel for their situation. When we consider the numerous enjoyments from which the blind are excluded—when we reflect that the diversity and beauty of the surrounding objects, the varied landscape, the azure sky, the splendid firma-

ment, the exquisite perfection of the human form, all animated nature, and, in short, the endless wonders of the creation are to them unknown, we cannot but acknowledge that the privation of sight is one of the greatest misfortunes to which we can be exposed. We must, therefore, feel desirous to prevent, if possible, so irreparable a calamity;—we are naturally led to direct our attention to the investigation of the diseases from which blindness proceeds, in order to remove them altogether, or, at least, to palliate their effects.

Extensive as is the field which presents itself to the medical practitioner, there are no diseases in which more has been accomplished than in those to which the eyes are subject From the remotest period at which medicine was cultivated, these diseases were attended to. By slow degrees their treatment has attained that perfection which it now possesses, and such is the ability evinced in their management, that we may proudly refer to them as a proof of the excellence and obvious utility of the healing art.

In other diseases nature may often be supposed to effect the cure by her unassisted efforts, and the merit of the practitioner may, therefore, be considered rather doubtful, but in various ophthalmic affections, the dexterity of the operator alone can remove the complaint.

Of all the departments of operative medicine, that of the oculist requires the greatest judgment and dexterity. The organ on which he practises is of a structure so delicate, and at the same time so complicated, and the

diseases to which it is liable are so numerous, that it requires more than ordinary attention to investigate them thoroughly. Theoretical knowledge, and a perfect acquaintance with the general principles of medical science, are as necessary to the oculist as they are to the physician. The oculist who wishes to excel in his profession, and who is anxious to acquire a higher character than that of a mere mechanical operator, must not only possess dexterity of hand, and a neatness and facility of execution, but add to these essential qualifications, those of extensive physiological, and pathological science. The latter studies in fact constitute the only sure foundation on which he can hope to rest his pretentions to superiority, and possessing these, in the first instance, he will with less difficulty afterwards obtain the manual tact, necessary to render him an expert and successful practitioner.

Practical experience, when not reduced to general principles, is little else than vague experiment, the propriety of which is often doubtful, and which, even when successful, contributes but little to our improvement. It is the combination of science and experiment that extends our knowledge, enables us to discover truth, and assists us in our search after solid acquirements :— It is this which distinguishes the well educated practitioner from the illiterate empiric, and which can alone secure to the profession of medicine that high rank which it so justly occupies.

It is pleasing to reflect that, of late years, the system of medical education has been so much improved, and

that such extensive opportunities are now afforded for the cultivation of every department of the profession. The rapid progress which medicine is making towards perfection, in all its branches, is to be ascribed partly to the liberal preparatory education which medical practitioners are now expected to receive, by which their minds are properly disciplined, and prepared for the reception of professional acquirements. It is also to be ascribed, in a great measure, to the subdivision of medical practice, which is now more strictly attended to than heretofore.

Formerly it was usual with the same practitioner to combine in his own person the several branches of the healing art, and of course, from their extent and great diversity, it was impossible for him to arrive at excellence in all. In the first ages of society it was necessary that this should be the case. At present, in poor and thinly inhabited districts, there is often no regular medical practitioner, and persons of a totally different occupation are called upon to add to their proper business, that of the village surgeon, or apothecary. The rude practice of such persons is often successful, but, as I just remarked, such diversity of occupation, added to their total want of science, retards their progress, and renders them incapable of acquiring those general views which form the principal means of medical improvement. Until of late, even in cities, the advantages which result from the subdivisionof medical labour, seem to have been overlooked. This error is, however, rapidly disappearing, and the intellectual mist, which ignorance

created, and prejudice would willingly perpetuate, has almost dispersed.

" No one," as I observed on another occasion, now " doubts the advantages which result to the arts and sciences from their being separately cultivated; for it is evident, that they attain a greater degree of perfection when a few excel in each pursuit, than when every individual is slightly acquainted with several, without having a thorough knowledge of any. The division of labour is the great, perhaps the sole cause why man, in a state of society, is so much superior in power and intellect, to the untutored savage, whose wants are as few as those of some of the inferior animals, and whose enjoyments are scarcely greater than theirs. The division of labour, by assigning to each person his particular task, enables the community at large to procure in greater abundance, and on cheaper terms, the necessaries, as well as the luxuries of life. It accommodates all, and serves even those who are confined to the most laborious occupations, by placing within their reach indulgences which they could not otherwise procure. In fact, it is at once the cause and the effect of civilization—the cause, as it alone enables us to emerge from barbarism—and the effect, because a certain portion of refinement has a direct tendency to occasion a still further sub-division of those occupations which a progressive improvement has rendered necessary."*

* See Remarks on the importance of the Medical Profession, &c. page 43.

Such are the suggestions of theory;—but when theory and experience coincide, the one, by confirming the other, renders us more satisfied of the accuracy of both. In cities the practice of medicine is separated from that of surgery, and even hospitals have been founded for different classes of medical diseases, instead of receiving all kinds indiscriminately into the same institution as heretofore. The profession of surgery is also subdivided, and surgical establishments have been formed according to the same principle.

Numerous are the benefits which have resulted to society from the adoption of this system. During the late formidable epidemic, the advantages of fever hospitals were so obvious, that they were every where established, not merely with a view to separate the sick from the healthy, but to insure the more successful treatment of the diseased, by placing them under the care of persons conversant with the nature of the complaint. In other instances the utility of a similar classification has been equally obvious, but in none, perhaps, more than where establishments have been formed solely for the treatment of diseases of the eye.

In a late publication on the present state of the medical profession, I remarked that " Next to hospitals, for the treatment of contagious diseases, the establishment of institutions for those affecting the eye exclusively, has been productive of the most decided public benefit. To operate with success on an organ of such importance and so extremely delicate as the eye, it is necessary that the operator shall be in the constant habit of performing

similar operations. A steadiness, dexterity, and, if I may so speak, a certain slight of hand, only to be acquired by continued practice, are essential to the oculist. With this specific expertness, and this peculiar tact, the performance of operations on a large scale is incompatible. The constant habit of executing full-length portraits in general incapacitates the painter from taking good likenesses in miniature. The eye that has been engaged in contemplating Jupiter and its satellites, or the stupendous ring of Saturn, cannot at once accommodate itself so as to examine objects that are scarcely discernible without the assistance of a microscope."*

In proof of the correctness of this position, I believe I need only mention the NATIONAL EYE INFIRMARY. This Institution, which owes its existence to the exertions of *Mr. Ryall*, though of recent establishment, has nevertheless the merit of being the first of the kind in this kingdom. The circumstances which led to its formation, and an account of its progress, are detailed in the Reports, already submitted to the public by the Managing Committee, of whose generous support, zeal, and philanthropy, I cannot speak in adequate terms. *Mr. Ryall*, after having passed more than twenty years in the service of his country, and having filled various situations in the naval medical department, which afforded him the most extensive opportunities for improving the treatment of diseases of the eye, at the close of the late war directed his attention to Dublin, with a view to practise as an oculist.

* See Remarks, &c. page 45,

As no respectable practitioner had previously, in Dublin, devoted his attention to diseases of the eye exclusively, *Mr. Ryall* was immediately generally consulted by persons of all classes. For the poor he prescribed gratuitously; and from the singular success which attended his practice, and more especially the extraordinary rapidity with which his patients recovered, they applied to him to so great an extent, that the necessity of a public institution, established expressly for their relief, at once occurred to him. He voluntcered his professional assistance, and proposed that a committee should be formed, consisting of individuals anxious to co-operate, and ready to exert themselves in forwarding so desirable an object.

As might be supposed, his services were immediately accepted of. The institution was patronized by the Lord Lieutenant and Chief Secretary of Ireland, and influenced by their example, as well as actuated by private feelings of benevolence, numbers of the most distinguished characters for rank, talent, and respectability, pressed forward, and exerted themselves in promoting the objects of the institution.

The first general meeting of the subscribers was held in October, 1814, at which it was unanimously resolved,—" That the establishment of an institution " so truly benevolent and humane in its object, the " extensive benefits of which have been so generally felt " and acknowledged, in the other parts of the united " kingdom, appears to them to possess an irresistable " claim on public support and attention.

"That from the cases produced to them this day, "although in the infancy of the institution, and the "evidence which they afford of the well directed "ability and attention of the professional gentleman "at the head of it, they feel they are justified in "promising that its benefits will prove as exten- "sively useful as the most sanguine wishes of its "benefactors could lead them to hope."

That this institution has answered the most sanguine expectations of its founder and patrons, is fully established by the Annual Reports, from which it appears that since its commencement 7656 persons have been received as patients. Of this vast number 7082 have been cured, and 574 partially relieved, or dismissed as incurable or irregular.

The following is an abstract of the cases treated at this institution in the year 1819 :—

Acute inflammation,	410
Purulent inflammation of adults,	107
——————— of children,	118
Cataracts of one eye operated upon,	31
——— of both eyes,	28
——— congenital,	12
Iritis,	58
Fistula Lachrymalis, &c.	21
Protrusion of the iris	130
Opacities and ulcers of the cornea,	256
Vascular cornea with chronic ophthalmia,	29
Inversions and eversions of the eye-lids,	25
	1225

	Brought forward,	1225
Wounds and injuries,		34
Amaurosis,		114
Tinea and lippitudo,		89
Other diseases,		161
	Total,	1623

The above are simple statements of the facts connected with the National Eye Infirmary, and strongly as they speak in its favour, yet the reflections which they suggest, afford even more decisive testimony of its utility, by leading us to compare the benefits which this institution confers on society, with the advantages that result from establishments founded only with a view to educate, and support the blind.

The most striking and obvious difference, and one which immediately occurs, is, that the Eye Infirmary is *preventive*, while all of the latter description are *palliative* merely. No doubt, it is highly meritorious to alleviate the distresses of the blind:—to provide for their wants, and to afford them instruction and employment, is indeed a duty which the affluent owe to their less favoured fellow-creatures. To some, however, it may appear, that in performing this duty every thing has been accomplished to which the poor can have a claim, as objects of charitable relief; but this is not the case, except for those who labour under blindness, which no precaution could have averted. For them, it is evident, nothing can be done; and

so far the philanthropist enjoys the conciousness of having effected every thing for their relief, of which their situation would admit.

But when he considers that a great proportion of the blind were originally possessed of good sight—that their blindness was the effect of accident, neglect, or mismanagement, and would certainly have been prevented, had they possessed the advantage o competent professional assistance, he must then fee how insufficient, how limited, how inadequate, are all those means, which, instead of preventing the mischief, are directed only to palliate it after it has occurred. He must at once perceive, that an institution which averts calamity, and preserves to society the valuable services of industrious individuals, who would else have been a burden to themselves, has superior claims to public patronage.

Indeed, so obvious are the advantages of this institution, that similar establishments have been formed in other parts of the kingdom. None of them, I believe, are conducted by persons exclusively oculists, and so far they are defective; but still, though labouring under this serious disadvantage, they have nevertheless contributed greatly to the benefit of the poorer classes.

The cases of ophthalmic disease in which the application of local remedies is sufficient to effect a cure, are far more numerous than those which require the practical dexterity of the experienced oculist.

Inflammation of the eye, in its different varieties and progressive stages, is the most frequent cause of the loss of sight, by occasioning changes in the structure of the organ, which render it unfit for the performance of its proper functions. Exposure to cold, the small-pox, measles, and the purulent ophthalmia of infants, may be considered as including the principal causes of blindness, unconnected with original mal-conformation of the eyes. But, in all these instances, the prompt and judicious employment of topical applications is in general sufficient, it being rarely necessary, on such occasions, to have recourse to any of the more delicate operations.

In the treatment, however, even of the different kinds of inflammation of the eye, more experience and discrimination are necessary than might be at first supposed. In acute inflammation, the treatment is very different from that proper in the equally formidable inflammation which occurs in scrofulous habits, cases of the latter description obstinately resisting the means, that are alone to be relied upon, in those which belong to the former class.

In the minute ulcers which so frequently occur on the anterior part of the eye, and the presence of which it often requires great acuteness of sight, and a close inspection of the organ, to discover, an inexperienced practitioner, overlooking the original cause, of the disease, and directing his attention solely to the accompanying inflammation, would be

induced to depend entirely on leeches, blisters, and fomentations, remedies in such cases often altogether useless, and incapable of arresting the progress of the primary disease.

In the purulent ophthalmia of children it might be conceived, from the intolerance of light, the profuse discharge of tears, the great tumefaction of the eyelids, and other marks of violent inflammation, that the treatment usual in ordinary inflammation was particularly called for. But were the practitioner to depend solely on the common antiphlogistic remedies, the disease would soon terminate in the rupture of the eye, and the total evacuation of its contents.

Of all the diseases of the eye, that of purulent ophthalmia is perhaps the most formidable. In this country it is the most frequent cause of blindness. When neglected, it in general terminates in the total loss of sight. When judiciously treated, however, it is often surprising how soon a rapid amendment takes place, and the organ is either preserved, or deformity at least prevented.

The public are greatly indebted to *Mr. Ryall* for the attention which he has paid to this complaint in particular, for I can myself testify, that, through his means, sight has been preserved to vast numbers of children who must else have been totally blind. I consider his practice of freely employing a strong so-

lution of the nitrate of silver in ulcers of the cornea, and in the purulent ophthalmia, as one of the greatest improvements that has been made in the treatment of any disease. In these, such is the success of this application, that it may be almost considered a specific:—when properly applied, and occasionally assisted by subordinate means, it will rarely fail.

Since the formation of the institution there have been discharged cured of acute inflammation 2369 cases,—of ulcers of the cornea 618, and of purulent ophthalmia 395;—numbers of such magnitude as to afford the most satisfactory evidence of the extensive utility of the Eye Infirmary, even though nothing else had been accomplished.

It would, however, be an injustice to the founder of this institution to rest his claim to public gratitude on these services merely, important as they are. His singular success in the operative department of his profession, and more particularly in the removal of cataract, has so firmly established his character as an oculist, that persons from the most remote parts of the kingdom frequently present themselves in the hope of obtaining relief.

The novel circumstance of an individual blind from his birth having been restored to sight, spreads with rapidity in the country in particular, and hence it happens, that many are induced to apply in the expectation of experiencing equal benefit, although their

cases may be of a nature altogether dissimilar, and indeed totally incurable. The want of success in such cases is owing not to any failure on the part of the operator, but to a disorganized or defective state of the eye, which no surgical means can remedy. It is proper that this fact should be recollected, and that the public should be enabled to understand why such disappointment must happen in many instances, lest, from at first expecting too much, they might afterwards be led to underrate the value of those benefits, for which they are really indebted to the skill of the oculist.

It is to be lamented that the study of the animal economy is so much confined to practitioners in medicine. The idea that a knowledge of the human frame can only be acquired by actual dissection, an opinion which writers on anatomy are particularly fond of inculcating, has greatly contributed to repress all inquiries into this subject, except by persons who are expressly intended for the medical profession. Nothing, however, can be more erroneous than this impression. To acquire a general knowledge of the chief organs of the human body, to distinguish their mutual dependance and connexion, and comprehend the various purposes for which they are so admirably contrived, does not necessarily require that attention to anatomy which some have supposed.

To the practical surgeon, anatomy is of the first importance, and its study must, of course, occupy the

principal part of his time. To practise with success he must by actual dissection accurately examine the course of every important nerve and blood-vessel, in order that, in the exercise of his profession, he may know where to look for them, and thus operate with less risk to his patient. This acquaintance with minute anatomy may, however, be dispensed with by those who wish to obtain merely a general knowledge of the principal functions of the animal system. To understand all that is at present known respecting them requires neither a practical acquaintance with anatomy, nor any extraordinary exertion of the mind. Many persons are perfectly acquainted with chemical doctrines, who never performed a chemical experiment, and a general knowledge of the functions of the animal economy may equally be acquired without submitting to the unpleasantness of actual dissection. Indeed, when I reflect that the noblest of the Creator's works is the subject of inquiry;—that we are ourselves the object of our own study, I cannot but feel surprised that such a proportion of the liberally educated, are so deficient in physiological science.

I am persuaded that the interests of the medical profession have materially suffered from this cause, for, while any of its branches are involved in mystery, it becomes impossible, for the uninitiated, to distinguish between the empty pretender, and the regularly educated and well-informed practitioner. The public interest equally suffers, for it constantly happens that most of those who are conscious of a want

of professional information, endeavour to conceal their ignorance by an assumption of superior skill, which too often imposes on the superficial observer. Persons of this description, in the absence of intrinsic merit, generally aim at success by plausibility of manner, and a servile compliance with the prejudices of those with whom they associate.

It is to be hoped that the period is fast approaching when professional success must be acquired by other means, and that the public will become too enlightened to be thus imposed on. It is to be hoped that ere long, persons, at least of the better classes, will be fully competent to discriminate, and see through the thin disguise so often assumed in the medical profession. For this purpose all mystery ought to be discountenanced. For this reason also the properties of medicines should be explained, and a simplicity of practice adopted in the treatment of diseases, which the well-informed physician laments he is often, under the present system, not permitted to follow. To render medicine extensively beneficial, and to improve it permanently, it is necessary that the regular physician shall, by the most perfect candour on his part, repel, as unworthy of himself and of his profession, the suspicion of his wishing to conceal the nature of his practice, or of the remedies which he may employ. To those who are capable of understanding his reasons he should evince a readiness to explain them, satisfied that the really well-informed will, in consequence, appreciate his

merit the more highly, and be less disposed to censure his failures in those instances in which little could have been expected from the interference of art.

I have been led to offer these remarks from having occasionally observed, in many individuals, a readiness to ascribe to the incompetency of the practitioner every example of his want of success. Such persons either imagine that nature is never defective, or have persuaded themselves that art is superior to nature. They are not aware that the functions of the animal fabric are subject to derangement, from causes which the practitioner cannot possibly control; that disease is the inevitable result of organic life, and that health necessarily terminates in decay. Disease and, ultimately, total decay are inseparable from our existence. Until nature herself shall change, and our bodies assume a new form, and acquire a different structure, we must be prepared to expect such occurrences. The successive actions which constitute life cannot be indefinitely protracted, for these very actions, even when most healthy, tend to derange the structure of the organs by which they are performed, and sooner or later exhaust the vital principle on which they immediately depend.

When the structure of an organ is injured its functions must be impaired, or totally suspended. Thus, when the eyes are inflamed vision becomes painful and indistinct: when they are completely opaque, or in any way essentially deranged, total

blindness ensues. In such cases the prospect of recovery depends on the extent of the injury sustained and hence, to form an accurate opinion as to the result, the nature and functions of the organ must be previously understood. I shall endeavour, therefore, to give a general view of the healthy structure of the eye, of the mode in which its functions are performed, and of some of its defects which prevent the perfect exercise of vision.

Vision, or the sense of seeing, is that species of sensation by which the mind acquires a knowledge of the colour, situation, and apparent magnitude of external objects. The organ by means of which this is accomplished is called the eye. In many animals the eyes are altogether wanting, as in zoophytes, in several worms, in most of the molusca, and in the larvæ of some insects. In all vertebral animals they are two in number, and are placed in cavities formed for that purpose by the bones of the cranium and face. In man the eyes are situated immediately below the forehead, on each side of the nose. The essential part of the eye consists of the globe, or ball, which occupies the principal portion of the orbital cavity. Subservient to the protection and motion of the eye itself, are the eye-brows, eyelids, the caruncula lachrymalis, and puncta lachrymalia, externally; and internally, the lachrymal gland, the fat which lines the orbit, and the muscles inserted into the globe of the eye.

The immediate organ of sight is a membrane placed at the bottom of the eye, which receives the impression of the rays of light that proceed from external objects, and enter the eye. The manner in which this is effected is so admirable, that, of all the instances of the wonderful perfection of our structure, and of the divine intelligence which directed our formation, the organ of sight may be considered the most singular and striking.

The globe of the eye consists of different parts, which, however different in form and structure, tend nevertheless to the same object—the concentration of the rays of light on the immediate organ of sight. In its figure the eye is not strictly globular, the anterior part being rather prominent. It consists of three different humours, the aqueous, crystalline, and vitreous, which are not concentric, but situated transversely with respect to the greater axis of the eye. These humours, of which the two last are contained in distinct capsules, are surrounded by the coats which constitute the outer part of the globe of the eye, and give to the entire its spherical form.

Of these coats the most external is the conjunctiva, a mucous membrane which lines both the eye-lids, and covers the anterior, and visible portion of the eye. Its use is to secrete a thin, watery fluid to defend the eye from the action of the air, to lubricate its surface, and prevent it from adhering to the eye-lids. It also, by its great transparency,

increases the lustre of the eye, and facilitates the transmission of light.

Another tunic is the sclerotic, which covers the whole globe of the eye, with the exception of the coloured circular space, in the front, where the white ends Here the sclerotic terminates, the remainder being filled up by the cornea. Formerly the cornea was considered a continuation of the sclerotic, but it is now ascertained to be a distinct membrane. Both however may be regarded as continuous, the entire coat thus formed being that which determines the shape of the eye. As the contents of the eye are for the most part fluid, the ball of the eye must be spherical, or nearly so, whenever the sclerotic is soft and flexible. This is the case in men and quadrupeds. In those animals, however, in which the eye departs much from a spherical form, as in the cetacea, fishes, and birds, the sclerotic is supported by hard parts, or possesses a greater thickness and solidity of texture.

In most of the mammalia the sclerotic is a whitish, opaque membrane. In the whale it is evidently a continuation of the dura mater, so that the opinion of the ancients on this subject is correct. In birds it is thin and flexible posteriorily, and its anterior part is divided into two laminæ, between which are placed, in a circle round the cornea, about twenty small, thin, oblong bones. These give great firmness to the cornea, and enable it to de-

part considerably from a spherical form, rendering the eye greatly elongated and prominent. In fishes it is cartilaginous, semi-transparent, and elastic, so as to preserve its form independently of any resistance made by the fluids of the eye itself. In all animals the sclerotic is double, for a thin membrane, in general of a blackish colour, closely adheres to its internal surface. This last is supposed to be a continuation of the pia mater. The muscles which move the eye are inserted into the sclerotic, and, from its flexibility in man and quadrupeds, it may be compressed by them, so as to cause the cornea to project more at one time than at another.

Beneath the sclerotic is the choroid coat, which is of a black colour. The sclerotic and choroid are loosely connected by cellular substance. Near the margin of the cornea, where the choroid ends, they are however closely united by a circle of a more dense substance, called the ciliary ligament. From this ligament an annular membrane, perforated in its centre by a small hole, the pupil, proceeds internally towards the axis of the eye. The posterior surface of this membrane was named by the ancients the uvea, from its colour, which resembles that of a grape. The anterior surface which appears through the cornea, is called the iris, from the variety of its colours.

The iris is essentially distinct from the uvea, although it is by no means easy to separate them.

At the edge of the pupil it is extremely thin;—near the ciliary ligament, where it seems to terminate, it is thicker, and adheres to the uvea more loosely.

The pupil, or perforation in the iris, varies in shape in different animals. In man, monkies, and birds, it is round, both when dilated and contracted; but in others, as in the cat, it approaches a vertical line, which is more narrow in proportion as the light is more intense. In the human fœtus the pupil, prior to the seventh month, is closed by a membrane which receives its vessels from the uvea. After the seventh month it disappears, so that no traces are observed in the new-born infant.

The next tunic which remains to be described is strictly an expansion of the optic nerve, which, passing through the choroid coat, forms a lining to its entire extent, but without adhering to it. From its delicately reticulated structure, it is called the retina. It is semi-transparent, soft, and of such little consistence as almost to tear by its own weight. When immersed in spirits of wine it becomes more firm. It is the most sensible part of the entire body, for light, which possesses no momentum, and is incapable of producing sensation in any other organ, occasions great pain when it falls on the retina in a concentrated state.

I mentioned that the humours which occupy the cavity of the globe of the eye are three, the aque-

ous, crystalline, and vitreous. The aqueous is a limpid fluid which fills the space between the cornea and the anterior surface of the crystalline. The iris is suspended in this humour, but is placed much nearer to the crystalline than to the cornea, so that only a small portion of the aqueous humour exists between it and the crystalline. The space between the cornea and the iris is called the anterior chamber, and that between the iris and crystalline, the posterior chamber of the eye. They communicate with each other by means of the pupil. In man the specific gravity of the aqueous humour is as 1009 : 1000.—Of course it is heavier than distilled water. It possesses a slightly saline taste, and is not rendered turbid by alcohol. This humour may be permitted to escape without injury to the eye, by puncturing the cornea, as it is quickly regenerated, and the eye again resumes its former fulness.

Immediately behind the aqueous humour is the crystalline, enclosed in a membranous capsule Its form is that of a convex lens, of which the posterior portion in general consists of the segment of a smaller sphere. In birds it is considerably flattened. In most of the mammalia it is more convex, and in fishes nearly spherical. Its size and convexity are in an inverse proportion to the size and convexity of the aqueous humour. Hence, if the figure and size of either be given, we may pronounce with tolerable certainty as to those of the other. Thus, since in fishes the crystalline is almost spherical, the aqueous

humour is extremely small, and in some instances even seems to be entirely wanting. In birds, on the contrary, as the lens is flat, the cornea is proportionably convex. In point of consistence the crystalline varies in different animals. It is most hard in those animals in which it is most convex. In birds and mammiferous animals it may be easily bruised. The central part of the crystalline is always harder and more dense than the edges or surface. It principally consists of albumen, as it becomes solid and opaque when exposed to the action of heat, or of alcohol. Its specific gravity is nearly 1000.

The vitreous humour which fills all the space between the retina and crystalline, and consequently occupies the greater portion of the eye, is also contained in a peculiar membrane. The cavity of this membrane is divided into innumerable cells, by transverse membranes of the most perfect transparency, which intersect each other in every direction. In consequence of this arrangement, the vitreous humour, with which the cells are filled, cannot easily flow out, and therefore does not appear to be fluid, although it is strictly so. When first separated from the eye, the vitreous humour with its capsule, possesses the consistence of the white of an egg. It is of an albuminous nature, and when long immersed in spirits of wine, sometimes becomes quite solid.

According to a late analysis of the humours of the eye, by *Berzelius*, the *aqueous* humour in 100 parts

affords 98.10, and the *vitreous* 98.40 of water, so that the quantity of solid matter in each is very trifling, and the density of both almost the same. The lens is stated by the same chemist to contain in 100 parts, 58 only of water. In the ashes of the crystalline lens, he fonnd some traces of iron, and discovered a considerable proportion in the black pigment which covers the choroid coat.

When the eye has been frozen, and equally divided in the direction of its axis, the space occupied by each humour may be compared with the entire length of the axis, and accurately measured. In man, if the axis be divided into twenty-two parts, the aqueous humour will be found to occupy only three;—the crystalline four;—and the vitreous humour fifteen of these parts. In the sheep, of twenty-seven parts, the aqueous humour occupies four;—the crystalline eleven;—and the vitreous twelve. In the herring, of seven parts of the axis, the crystalline alone, occupies five, and the other two humours only one part each.

In man the muscles of the eye are six, and arise from the margin of the hole, at the bottom of the orbit, through which the ophthalmic nerve passes. They are inserted into the anterior part of the globe of the eye, as far as the edge of the cornea, and increase the thickness of the sclerotic. Of these four are called *recti*, or *straight*, and are placed opposite to each other. The superior raises the eye,

and the inferior depresses it. The internal enables us to direct it towards the nose, and the external towards the temple. The two remaining muscles are oblique; they serve to counterbalance the former, and render the motions of the eye steady and regular.

Of the internal parts of the eye, the iris, from its great irritability, and contractile powers, is evidently muscular. In the East Indian rhinoceros, a muscular membrane exists, which arises from the back of the sclerotic, and loses itself in the choroid coat, near the broadest diameter of the eye. This peculiar muscular structure seems to be for the purpose of enabling the animal to produce certain changes in the form and relative distances of the humours of the eye, and, as it is not easy to assign to it any other use, strongly confirms the opinion that such changes do take place.

Such are the principal parts of which the eye consists. Even the superficial description which I have given of them, will enable us to acquire a general view of the manner in which vision is accomplished.

The immediate object of the sense of vision is *light*. From the sun and other luminous bodies, particles of a peculiar substance continually emanate. These particles move in right lines, with inconceivable velocity, and are more or less reflected from the surfaces of

the surrounding objects. Such particles as enter the eye, and arrive at the retina, excite a peculiar sensation, by which we perceive that light is present. Different impressions however, are produced according to the kind of light, for light is not uniform and homogeneous, but, in reality, composed of seven different kinds, each of which occasions a distinct sensation.

The seven primary colours,—red, orange, yellow, green, blue, indigo and violet, variously compounded, and reflected in different proportions, constitute the infinite diversity of shades, and give to bodies the endless variety of appearance which they possess. But the mere existence of light, and the entrance into the eye of different colours, are not sufficient to render objects visible, unless the rays of light reflected from those objects, are conducted to that part of the eye formed to receive their impression, and applied to it so as to convey a distinct representation of the objects from which they proceed. The exact image of the objects of vision must be impressed on the retina, and to this purpose, all the other parts of the eye are subordinate.

To produce this effect, it is necessary that the rays of light should be brought to a focus on the retina. This is done, by the refractive powers of the different humours, in this way. The rays which proceed from any object to which the axis of the eye is di-

rected, first fall on the convex surface of the cornea. In consequence of the convexity of the cornea, and in conformity with the well known laws of refraction, they are rendered more parallel in their passage through the aqueous humour. Arriving at the crystalline lens, the density of which is greater than that of either of the other humours, their convergency is still further increased, by its refractive powers, and therefore on entering into the vitreous humour, their direction is such that they are collected on the retina, and there form a perfect image.

In consequence of the change of direction given to the rays in their passage through the different humours of the eye, they cross each other, and the image which they form is, of course, inverted with respect to the object. This is proved experimentally, by removing the eye of an ox while it is yet warm, and carefully separating the posterior coat. The images of external objects will then appear, painted on the retina in an inverted position. It has been objected to this fact that, were this really the case, objects ought to appear inverted, a circumstance that would necessarily occasion great inconvenience to the spectator. Those who offer such an objection, seem not to recollect that *all* objects are equally inverted, and that viewing them always under the same circumstances, the mind immediately judges of their situation, without either difficulty or confusion. In this, as in many other instances, we are determined

by our previous experience, and finding that, under certain circumstances, certain impressions are regularly produced, we expect them to follow as a matter of course, and we reason and act accordingly.

When the rays of light form the image immediately on the retina, vision is distinct, but sometimes the rays converge before they arrive at the retina, and sometimes, on the contrary, their divergency is so great that they reach the retina without being sufficiently collected. When the rays converge too soon, the person is said to be *near* sighted, and when they converge to a point behind the retina, the individual suffers from the opposite defect of *long* sight. The medium distance at which persons in general, can distinctly view minute objects, is about seven or eight inches. Objects more or less remote are less clearly seen, and would always be obscure, were it not that the form of the eye accommodates itself to their different distances. Rays which proceed from remote objects are more parallel than those which arrive at the eye from a nearer point. Of course, to obviate the inconvenience that must result from this circumstance, it is necessary that, in the former case, the refractive powers of the eye should be diminished, and in the latter case increased. Were the refractive powers of the eye to continue always the same, it is evident that, if the eye were so constituted as to collect on the retina such rays as were parallel, or nearly so, at their entrance, rays more di-

vergent must tend to form an image behind the retina, and *vice versâ*—were it to bring the more divergent rays to a focus on the retina, those that are less so, must form an image before the retina.

This, which would be a serious defect, is remedied by an admirable contrivance, and one which must convince us that we owe our formation to a being of infinite power and wisdom,—that the hand which formed us is divine, and that in every instance, as far as our limited faculties will enable us to discover, the means by which each object is attained, are the best and simplest possible. The eye alters its figure, and the cornea becomes more or less convex, in proportion to the greater or less divergency of the rays. The nearer the object, and consequently the more divergent the rays, the greater is the increase in the length of the axis of the eye; but when the object is more remote, and the rays are more parallel, the cornea is less convex, and the length of the axis is of course diminished. These changes are produced by the action of the muscles of the eye, which by compressing it laterally, cause the aqueous humour to project more or less, so as to adapt the focus to the distance at which the object is viewed.

This change in the length of the axis of the eye, has been demonstrated by a very ingenious and decisive experiment. *Mr. Ramsden* fixed the head of

a spectator so firmly in a frame constructed for the purpose, as to preclude the possibility of any change in its position. Having directed the spectator to fix his eye on a distant object, he marked accurately, by means of a microscope, the precise situation of the outer surface of the cornea. The spectator was then instructed to view a nearer object, and the cornea was observed instantly to project beyond the former point.

When the humours of the eye are too convex to admit of being adapted in this way to the distinct inspection of remote objects, the use of a concave lens will remedy the defect, by dispersing the rays; and when, on the contrary, the eye is too flat, a convex lens is employed in order to collect them, and assist the eye in bringing them sooner to a focus. For this purpose spectacles have been invented. The young and middle aged in general require concave glasses, but persons of a more advanced period of life, use such as are convex and magnify.

The influence which habit exerts in correcting the defects of vision is very great. All our ideas of sight are those of the figures of coloured bodies drawn on a plane surface, but having ascertained by experience that coloured figures of a particular appearance, indicate particular kinds of tangible forms, we afterwards by habit, and almost as it were intuitively, substitute for the immediate idea of vision, the real

idea of the tangible figure. The art of painting depends on this principle, and hence it is that, when the pencil of the painter most deceives us, his efforts are pronounced to be most successful. To habit we also ascribe the circumstance that objects appear single, although of each object two images are formed, one in each eye. Experience teaches us that the two images belong to a single object, we therefore soon learn to infer the existence of the single object, and pay no attention to the impression of the double image. Some writers have attempted to explain this fact by supposing that, as the image of the same object falls on a corresponding part of the retina, in each eye, the sensation of a single image only is produced, and communicated to the sensorium. This however is a most erroneous hypothesis, for the image in every instance is double, as any one may convince himself by a simple experiment. If we close one eye, and refer an object held before the other, to a certain fixed point at some distance: by attentively marking that point, shutting the eye, and opening that which was closed, we will find that the object appears to occupy a different position, and must be referred to a different point. By practising this, three or four times, and then opening both eyes, we shall see the object double, our previous experience of the existence of a distinct image in each eye, restoring to us our true sensations, and proving for the time, superior to the influence of former habit.

To produce constant vision it is not necessary that the particles of light should be applied to the retina, in immediate succession, and without the slightest interruption of continuity, for the retina when once stimulated into action, retains the impression of light for a short period of time, even after the light has been withdrawn. This explains why, if a burning coal be rapidly whirled round in the dark, it produces the idea of a luminous circle, the impression made on the eye in any one part of its circuit, continuing during the period of the entire revolution. Hence, in a dark night, meteors and falling stars seem to leave a lucid train behind them, and hence, a distant prospect, when viewed through the spaces between the radii of a rapidly revolving wheel, appears nearly as distinct as if nothing intervened.

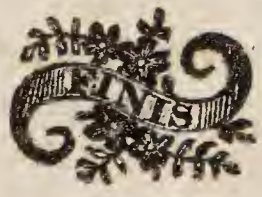
These appearances are observed by the eye in its ordinary state; but the retina is sometimes too sensible, sometimes it is deficient in sensibility, and sometimes it is easily excited into irregular action, from all of which causes different kinds of imperfect vision proceed, the origin and nature of which the physiologist alone can explain.

To enter minutely into these subjects, interesting as they are, would be to trespass too much on your time. To explain all the kinds of defective vision would far exceed the limits, and would indeed be incompatible with the object of an introductory lecture. Perhaps, on a future occasion, I may offer some remarks relative to those defects of the sight which

it belongs to the physician to treat of, and which frequently occur in various medical complaints.

In the operative department, *Mr. Ryall* will afford, to the pupils of the institution, every facility that can assist them in acquiring a knowlege of the practice which he pursues, and will illustrate his mode of treatment, by constant reference to appropriate cases.

19, *York-st.*—13*th Nov.* 1820.



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REMARKS

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